CHAIR BACK CONSTRUCTION

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates generally to a chair of the type suitable for use in an office environment and, more particularly, to a reclining office chair having several structural and operating features which offer a number of ergonomic advantages over the prior art including a highly functional and aesthetically pleasing chair back.

2. Description of the Related Art

[0002] Over many years attempts have been made to design chairs for use in office environments which are comfortable to use and thereby avoid user fatigue over prolonged use. In one simple form a chair may be provided with a swivel base for ease of turning and include a control mechanism which permits the chair to rock. A disadvantage of these relatively simple chairs is that conjoint rocking motion of the chair seat and back naturally lifts the user's feet off the floor, which can create stability problems and place upward force on the front of the user's thighs which can reduce fluid circulation in the user's legs.

[0003] To improve on the foregoing chair construction, chair controls are known which provide for synchronous movement of the chair seat and back. Where office chairs are concerned, a "synchronous control" means the arrangement of a combined or dependent back adjustment and seat adjustment, that is to say the adjustment of the back inclination fundamentally also results in an adjustment of the sitting surface. An example of a synchronous chair control is disclosed in U.S. Patent No. 5,318,345, issued to Olson and assigned to the

common assignee herein. With the aforementioned Olson control, the chair back is designed to tilt at one predetermined rate of recline while the seat tilts synchronously at a much lesser rate. The result is that the user's feet are not lifted from the floor when the back is reclined. Also, fluid circulation in the user's legs is not interrupted by substantial upward movement of the forward end of the seat. Another advantage of this control is that undesirable "shirt pull" is minimized by the strategic location of the tilt axis. Other examples of synchronous chair controls are disclosed in U.S. Patent Nos. 5,366,274 and 5,860,701 to name a few.

[0004] Another feature embodied in recently designed office chairs that offers considerable ergonomic advantages is a tilt limiter feature for the chair back. With such a mechanism built into the chair control, the user may selectively set the degree of back recline at a predetermined angle thereby adding to comfort as the chair is used. An example of such a tilt limiter mechanism is disclosed in U.S. Patent No. 6,102,477 issued to Kurtz and assigned to the common assignee herein. This particular mechanism offers the advantage of providing for infinitely variable angles of tilt within a predetermined overall range. The mechanism is also highly cost-effective to construct.

[0005] Yet another feature of current ergonomically designed chairs is the provision of height and pivot adjustable arm pads. Such a feature is particularly advantageous in providing the user with additional support to the arms, forearms, wrists and shoulders in order to minimize repetitive stress injuries when the user is keyboarding, for example, while seated in the chair. An example of such an adjustable arm pad is disclosed in U.S. Patent No. 5,908,221 issued to Neil. One advantage of the '221 structure is that it uses gas cylinders for arm pad height adjustment and thus is easily adjusted with the push of a single button.

[0006] Yet another feature of current ergonomically designed office chairs includes an adjustable lumbar support mechanism for providing preselected chair back tension in the region of the user's lower back. An adjustable lumbar support allows the chair user to select a comfortable level of pressure on the lower back depending upon the specific office task being performed. Such a mechanism is disclosed, for example, in U.S. Patent No. 5,797,652.

[0007] Still another feature of certain ergonomically designed office chairs, particularly of recent vintage, is the incorporation of fabric mesh into the construction of the chair seat, and/or back. While mesh materials are well-known in the construction of lawn furniture seating, it has only been relatively recently that such materials have been used successfully in office seating. These materials offer the advantage of enhanced air circulation for and consequent heat transfer from the chair user's body, which can improve the comfort of the chair. An example of the use of such fabric mesh in an office chair is disclosed in U.S. Patent No. 6,125,521 issued to Stumpf et al.

[0008] Yet another feature of certain ergonomically designed chairs is the provision of a seat cushion having the capability of effecting heat transfer from the chair user's buttocks area while at the same time offering comfort to the user while seated, together with adequate support. Known seat cushions having such capability may involve a passive or active air flow circulation feature of the type disclosed, for example, in U.S. Patent No. 6,179,706.

SUMMARY OF THE INVENTION

[0009] The present invention provides a totally redesigned ergonomic chair that incorporates improved functional aspects in all areas of a modular chair construction and in its use, including

tilt limit control, seat adjustment, arm adjustment, lumbar support, cushion airflow, mesh attachment and modular base frame assembly.

[0010] The various subfeatures of these modular components are the subject of the following individual applications filed of even date herewith, all commonly assigned, the disclosures of which are incorporated in full by reference:

Multi-position Tilt Limiting Mechanism
Attorney Docket: 785153

Locking Device for Chair Seat Horizontal Adjustment Mechanism
Attorney Docket: 785157

Height and Pivot Adjustable Chair Arm
Attorney Docket: 785154

Lumbar Support for a Chair
Attorney Docket: 785145

Body Support Member
Attorney Docket: 785152

Ergonomic Chair
Attorney Docket: 785135

Chair of Modular Construction
Attorney Docket: 785173

[0011] In each of these cases, features combine to provide an overall chair that is a significant improvement over the prior art.

[0012] Thus, for example, the present invention provides a reclining chair having a four bar linkage system that causes the rear of the seat to elevate as the back is reclined lending an unusual and comfortable balance during reclining. A tilt limit control conveniently and effectively limits the degree of chair back tilt to one of three reclined positions by manual

movement of a simple lever. Horizontal positioning of the chair seat cushion is accomplished using a simple locking device that allows the chair user to simply lift up on the front of the cushion and select a preferred horizontal cushion position. Height and pivot adjustable chair arms are actuated with the push of a button by gas cylinders lending convenient adjustment to suit a specific work task. A lumbar support is easily height adjustable, by providing tension to the back frame and requires no screws or adjustment knobs in its adjustment mechanism. A modular cushion includes a comfortable heat absorbing gel layer and is vented uniquely for air circulation. The back of the chair is of fabric mesh construction and includes a novel attachment system for superior comfort. The base of the chair is of modular construction that provides for ease of assembly and lends rigidity to the chair construction.

[0013] The present invention improves over the prior art by providing a back for a chair including a fabric panel with a flexible carrier attached to the panel around its periphery. The carrier is configured to be secured along a bottom edge to a bottom portion of a chair back frame member. The carrier is also secured to two vertical frame supports at its two upper corners. Preferably, the upper carrier and frame connections are ball and socket joints.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The foregoing and other novel features and advantages of the invention will be better understood upon a reading of the following detailed description taken in conjunction with the accompanying drawings wherein:

[0015] FIG. 1 is a left front perspective view of an ergonomic chair constructed in accordance with the principles of the invention and incorporating all of the improved modular components;

[0016] FIG. 2 is a right front perspective view thereof;

[0017] FIG. 2a is an exploded perspective view thereof;

[0018] FIG. 3 is a right side view thereof;

[0019] FIG. 4 is a left side view thereof;

[0020] FIG. 5 is a front view thereof;

[0021] FIG. 6 is a rear view thereof;

[0022] FIG. 7 is a top view thereof;

[0023] FIG. 8 is a bottom view thereof;

[0024] FIG. 9 is a bottom view thereof with the chair base removed;

[0025] FIG. 10 is a partial left side view illustrating the chair in a fully upright position;

[0026] FIG. 11 is a partial left side view of the chair shown in a partially reclined position;

[0027] FIG. 12 is a partial left side view of the chair shown in a fully reclined position;

[0028] FIG. 13 is a side schematic view showing the linkage arrangement of the chair;

[0029] FIG. 14 is a side schematic view showing the kinematics of the chair;

[0030] FIG. 15 is a front perspective view of the chair back assembly;

[0031] FIG. 16 is an exploded perspective view thereof;

[0032] FIG. 17 is a cross-sectional view taken substantially along the line 17-17 of FIG. 15;

[0033] FIG. 18 is a cross-sectional view taken substantially along the line 18-18 of FIG. 15;

[0034] FIG. 19 is a cross-sectional view taken substantially along the line 19-19 of FIG. 15;

[0035] FIG. 20 is a perspective view of the chair back illustrating the adjustability of the lumbar support;

[0036] FIGS. 21-30 illustrate alternative constructions for the lumbar support;

[0037] FIG. 31 is an enlarged plan view of a portion of fabric mesh suitable for use in the present chair back construction;

[0038] FIG. 32 is a cross-sectional view of one form of the carrier and mesh attachment system;

[0039] FIG. 33 is another cross-sectional view of the carrier and mesh attachment system;

[0040] FIG. 34 is a cross-sectional view of the upper attachment construction of the chair back; and

[0041] FIG. 35 is a cross-sectional view of the bottom attachment construction of the chair back.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0042] Referring now to the drawings, and initially to FIGS. 1, 2 and 2a, an improved ergonomic chair constructed in accordance with the numerous principles of the invention is shown in front perspective and designated generally by the reference numeral 10. The chair 10 comprises as its principal components a seat 12 and back 14. Suitable arms 16 having upper pads 18 may be provided. The chair 10, in a conventional manner, may be supported on a spider base 20 movable on casters 22.

[0043] As shown in FIGS. 3-9, the chair 10 is so constructed as to have synchronous movement of the seat 12 and back 14. To this end, a pair of main seat and back supports 24 are rigidly attached to a central support module 25 having a hub 26 for frictionally receiving the upper end of a gas cylinder 28. The gas cylinder 28 is preferably a two-stage type available from Stablis GmbH of Germany. This cylinder 28 is operable by a manually pivotable lever 30 which activates the cylinder 28 for height and adjustability of the chair 10 in a manner well-known in the art. The chair arms 16 are rigidly connected to the supports 24. A seat pan 32 is pivotably connected at its front end to the forward end of the supports 24. A support (skeleton?) back frame assembly 34 is also pivotably connected to the upper rear of the supports 24. The chair back 14 in the preferred embodiment is of fabric mesh 36 construction supported around its periphery by a carrier 38. An adjustable lumbar support member 40 slidably connects to the carrier and bears against the back support assembly 34.

[0044] The relative portions of the seat 12 and back 14 of the chair 10, during reclining of the back 14, can be seen in the side views of FIGS. 10-12. As illustrated in these views, the chain seat pan 32 is pivotably connected at pivot points P_{12} to the supports 24 (only one of which can be seen) and is pivotably connected at rear pivot points P_{32} to a pair of links 42 (only one of which can be seen). Each link 42 in turn is pivotably connected at point P_{34} to forward extensions of the back frame assembly 34. The back frame assembly 34 is also pivotably connected at point P_{14} to the two supports 24. As shown in the three stages of back tilt illustrated in FIGS. 10-12, as the back 14 reclines rearwardly, the link 42 moves in a counterclockwise direction of rotation causing the rear of the seat pan 32 to elevate relative to its front. This synchronous motion of the seat pan 32 and back 14 provides for an exceptionally comfortable

reclining motion of the chair 10 user to aid in avoiding fatigue as the user is performing various work-related tasks.

[0045] Shown now in FIGS. 13 and 14 are schematic views of the synchronous seat and back tilt feature employing a four-bar mechanism which allows the rear of the seat to elevate as the backrest is reclined. The mechanism is designed to immediately respond to a user exerting a back force and/or self-weight on the seat. This function allows for reclining of the chair 10 about a rotation point C that is very closely coincident with the pivot axis of the user's hips and avoids undesirable "shirt pull" of the user. Because the rear of the seat is elevated during back reclining, excess pressure is relieved at the front underside of the user's thighs, and also a relatively constant gaze angle is maintained during reclining. This provides for adequate fluid circulation in the user's legs and avoids swelling. To accomplish the foregoing advantages, the chair 10 comprises four basic members and four rotationally-free pivots. The basic members include a floor supported member 60, a seat rest 62, a linking member 64 and a backrest 66. The floor supported member 60 has an upwardly directed portion 68 that terminates at an end defining pivot point P_{12} to which the seat rest 62 is pivotably connected at its forward portion. The member 60 also has an upwardly directed portion 70 which terminates at an end defining pivot point P_{14} to which the backrest 66 is pivotably connected. A lower portion 72 of the back rest 66 is pivotably connected at point P_{34} to the linking member 64 and a downwardly extending portion 74 of the seat rest 62 is pivotably connected at point P_{32} to the other end of the linking member 64.

[0046] The kinematics of the chair 10 are illustrated in FIG. 14. As force F is applied on the backrest 66, the back tilt angle β increases, eye location shifts backwards an amount $\Delta DH1$, and

eye elevation decreases by an amount ΔDV3. The change in back tilt angle β transmits motion by way of the upper and lower back pivots P_{14} and P_{34}, respectively, to the linking member 64. As a result of motion set in linking member 64, the rear seat pivot P_{32} moves in coordination with pivot P_{34} in a composite rotational and translation motion. As the seat rest 62 rotates about pivot P_{12}, a lift ΔDV2 is caused in the rear part of the seat rest 62 relative to its front edge ΔDV1 in the amount ΔDV2-ΔDV1, therefore introducing a seat rest angle α. The user sitting in the chair will feel a weight reduction effect as a result of the lift. The apparent weight reduction will be sensed as lightness and give the feel of comfort.

[0047] It can now be appreciated that a chair 10 constructed according to the invention offers considerable advantages in user comfort by virtue of its synchronous linkage construction particularly where it is used for prolonged periods of time. The chair 10 is also cost effective to manufacture and assemble.

[0048] Turning now to FIGS. 15 and 16, the complete back 14 of the chair is illustrated in perspective and shows the novel feature of the lumbar support construction. As earlier noted, the chair back 14 comprises a fabric mesh material 36 supported around its periphery by a semi-rigid bendable carrier 38. Main backframe member 34 consists in preferred form of two generally vertical supports 102 connected proximate their upper ends by a brace 104. The bottom ends of the supports 102 bend inwardly and terminate at a forwardly projecting member 106 which serves to provide aforementioned pivot point P_{34}. Transverse member 108 is provided with a pair of spaced arms 110 which are attached as by screws 112 to the two supports 102. The member 108 provides a lower attachment point for the carrier 38.

[0049] In accordance with the invention the back assembly 14 includes a transverse lumbar support tube 120 having gripping means 122 on each of its opposed ends, together with a pair of spaced slide members 124. A cross-section of the gripping means 122 can be seen in FIG. 17 wherein the carrier 38 is provided with a pair of opposed recesses 126 into which opposed projections 128 of the gripping means 122 are slideably received. Thus, the support tube 120 is slideable on opposed edges of the carrier 38.

[0050] FIG. 18 illustrates a cross-sectional view of the support tube taken substantially along the line 18-18 of FIG. 15. There, it can be seen that slide members 124 are configured to engage vertical supports 102. As shown in FIG. 19, the engagement arrangement of the slide members 124 includes a simple vertical grooves 130 in the supports 102 by means of a central rib 132. It can now be appreciated, particularly with reference to FIG. 20, that the lumbar support tube 120 is vertically moveable between upper and lower positions as it slides on edges of the carrier 38 by means of the gripping means 122 and also slides on the vertical supports 102 by means of the slide members 124. The result of such movement is to allow the chair 10 user to adjust the vertical height of the tube 120 by simply manual manipulation. The tube 120 is held in proper connection to the supports 102 by just the tension of the carrier 38 and mesh 36. In this tension mode the tube 120 causes the carrier 38 and mesh to be forced forwardly of chair 10 in the lumbar region of the user.

[0051] Alternative lumbar support systems using the mesh 36 and carrier 38 assembly can be seen in FIGS. 21-30. In FIGS. 21 and 22, it can be seen that a single central support 150 may be employed having top and bottom braces, 152 and 154, respectively, to secure the four corners of the carrier. A lumbar support tube 156 may be slideably supported on the central support 150 and have gripping means 158 for slideably gripping opposed edges of the carrier 38.

[0052] In FIGS. 23 and 24, a system is shown wherein a central support `60 and upper and lower braces, 162 and 164, respectively, a threaded rod 166 and knob 168 are employed to selectively move a lumbar support member 170 forwardly and rearwardly to adjust tension in the mesh 36. The system may also be constructed with a slot 172 through which the rod 166 passes to vertically adjust the member 170 as it slides on the carrier 38 using gripping means 174 as described above.

[0053] FIGS. 25 and 26 illustrate an embodiment wherein a central support 176 and braces 178 and 180 and braces 178 and 180 are used. However, a two piece lumbar support member 182 is employed to adjust tension in the mesh 36 by means of a manually rotatable knob 184 and camming device 186.

[0054] FIGS. 27 and 28 show yet another embodiment wherein a central support 188 and braces 190 and 192 are used. However, in this construction a lumbar support member 192 is connected by a slideable bracket 194 to the support 188 and uses a link member 196 to adjust tension in the mesh 36.

[0055] FIGS. 29 and 30 show a further embodiment wherein a central support 198 and braces 200 and 202 as used. In this construction a two piece lumbar support member 204 is employed using a turnbuckle assembly 206 to adjust tension in the mesh 36.

[0056] Yet another novel and highly functional feature of the chair 10 that offers ergonomic advantages over the prior art is the construction of the chair back 14. As previously noted, the back 14 is designed to be formed of a panel of fabric mesh 36 which is preferably of an open weave type known in the art. The construction of the fabric mesh 36 may have a variety of weave configurations. One configuration that has proved to be advantageous is shown in FIG.

31 comprising vertical strands 220 of multifilament yarn and horizontal monofilaments 222. The monofilaments 222 in this construction can be seen to cross over the strands 220 and also crisscross over each other thereby locking the strands 220 in place.

[0057] In order to support the mesh 36 around its edges, the aforementioned carrier 38 is used. The physical connection of the carrier 38 to the mesh 36 may be performed in a number of ways. However, a most reliable connection is disclosed in co-pending U.S. patent application Serial No. 09/656,491, filed by Timothy P. Coffield on September 6, 2000 and titled Bonding Strip for Load Bearing Fabric. FIGS. 32 and 33 illustrate a carrier 36 comprising two halves 230 and 232 disposed on opposite sides of the edge portion of mesh 36. The two halves 230 and 232 may, in one form, be formed with internal grooves 234. The halves are placed in a fixture 236 together with an adhesive 238. The adhesive extends through warps and wefts of the fabric 36 and into pockets 240 formed by the grooves 234 and, once cured, creates a mechanical interconnection that is of high strength and durability.

[0058] In order to support the chair back 14, in accordance with the invention and referring once again to FIG. 16 the main back frame 34 has spherical end portions 240 formed on vertical support members 102 which are received within circular apertures 242 formed in the upper right and upper left hand corners of the carrier 38. Suitable retainers 244 and 246, one on each side of the carrier 38, are attached as by screws 248 around each spherical end portion 240 to essentially create ball and socket joints. These joints allow upper edge 250 of the carrier 38 to flex allowing the chair back 14 to comfortably conform to the position of the user's shoulders. The back may be secured along bottom edge 252 to the frame member 108 by screws 254. Details of the upper ball and socket connections may be seen in the cross-sectional view of FIG. 34, while the lower attachment construction can be seen in detail in FIG. 35.

[0059] It can now be appreciated that a chair back construction as just described offers considerable ergonomic advantages. The use of open mesh 36 allows the chair back 14 to not only breathe, but to flex in conformity with the back of the user. The back 14 is also highly cost effective to manufacture and assemble.

[0060] While the present invention has been described in connection with a preferred embodiment, it will be apparent to those skilled in the art that many changes and modifications may be made without departing from the true spirit and scope of the present invention. Accordingly, it is intended by the appended claims to cover all such changes and modifications as come within the spirit and scope of the invention.